PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in Spiral Tungsten Filaments.

We, THE GENERAL ELECTRIC COMPANY LIMITED, of Magnet House, Kingsway, London, W.C. 2, a British company, (the Assignees of PATENT TREUHAND GESELLSCHAFT FUR ELEKTRISCHE GLUHLAMPEN, M.B.H., of 11/14, Ehrenbergstrasse, Berlin, O. 17, Germany, a German company) do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to spiral tungsten filaments composed of long crystals, for electric incandescent lamps. The improved filaments differ from known filaments in that they consist of spirals formed from wire which has already been wound into a spiral and the crystals forming this double spiral are not distorted. Such double spiral filaments consisting of undistorted crystals are prepared by spiralling a tungsten wire, winding this spiral again in a spiral form in a known manner, and then producing the final crystal form by suitable heat treatment.

It has already been proposed to wind spirals of tungsten wire, produced by mechanical working in the usual way, into a second spiral so that a spiral of the second order results, in order to obtain a particularly compact filament, but such filaments have not been adopted as they do not retain their shape, as they either sag badly as soon as current passes through them or else distort in use. These defects are overcome in filaments prepared according to the present invention as the filaments composed of undistorted crystals, which are produced in the spiral of the second order by suitable heat treatment, retain their shape so much better than known double spiral filaments that distortion and appreciable sagging are prevented even after long running.

In carrying out the improved process, care must be taken that the filament, which, during the heat treatment, first acquires its ability to keep its shape, does not sag during the said heat treatment. The procedure may be as follows:—

Drawn tungsten wire, preferably containing the usual addition of a refractory oxide, such as thoria, is used as the starting material. This is heated until the fibrous structure begins to break down and it is then drawn down one or two stages. This wire is spiralled in the usual manner and, after removing the mandrel, this spiral of the first order is then wound on a mandrel of refractory material, for example tungsten to form a spiral of the second order, and its end attached to the mandrel. This spiral of the second order together with the mandrel is heated to well above 2000° C. until the final structure of long undistorted crystals is produced, and the spiral is then ready for use in the lamp after removing the mandrel. The filament may be heated by passing an electric current through it, or by any other method, such as, for instance, heating in a suitable tube furnace. As it is difficult to remove the mandrel after the final heating has been carried to completion, the spiral of the second order together with the mandrel may be heated only to about 1900° C. to 2000° C. and the filament alone, without the mandrel, raised to the final temperature. This final heating of the filament, after removal of the mandrel, may take place when the filament is mounted on the foot tube of the lamp, if desired. The process is not restricted to either of these two methods; it suffices generally that

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care should be taken that no sagging occurs during the heat treatment. This may be ensured, for instance, if the filament be placed on a grid composed of a number of tungsten wires stretched transversely to the spiral. Moreover it is not absolutely essential to commence with a wire, heat it until the fibrous structure begins to break down, and then subject it to one or two stages of drawing. An ordinary (preferably thoriated) tungsten wire may be taken as the starting material without any further preliminaries, especially if the mandrel of the spiral of the first order be comparatively small. Experience has shown that the re-crystallisation and the growth of the long crystals occur sufficiently without any special thermo-mechanical treatment, if the diameter of the spiral, and consequently of the mandrel, be small, for example, only two or three times that of the wire. So small a diameter of the mandrel means that simple spiral filaments as used at present would be inconveniently long, but the small diameter of the first spiral will not be detrimental, as the necessary shortening and compacting of the filament can be effected in the second spiralling. It is sufficient if the diameter of the spiral of the second spiral is ten times that of the wire.

In their final crystalline form, all filaments prepared in accordance with the improved process are composed of undistorted crystals or crystal particles. By the invention filaments of very small over-all length may be used in electric incandescent lamps, so that the efficiency of gas-filled lamps may be increased considerably. For example, the over-all length of a filament, according to the invention, for gas-filled lamps of 30 watts, 220 volts, may be shortened to about 10 to 12 m/m whilst the corresponding over-all length of a filament wound in a simple spiral is about 60 m/m. The more compact arrangement increases the efficiency by about 20%.

The more compact arrangements may be usefully applied in vacuum lamps, since the filament support may be made simpler and hence more cheaply. Further, the concentration of light, both in gas-filled and in vacuum lamps, is of advantage for many purposes, such as in projection lamps.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A spiral tungsten filament composed of long crystals for electric incandescent lamps, which consists of a spiral of the second order wound in a known manner from a spiral of the first order and in which the crystals composing this double spiral are not structurally distorted.

2. A spiral tungsten filament as claimed in Claim 1, wherein the diameter of the spiral of the first order is only two or three times, and that of the spiral of the second order is at least ten times, the diameter of the wire.

3. A process for the preparation of a spiral tungsten filament composed of long, undistorted crystals as claimed in Claim 1 or Claim 2, according to which a spiral wire of the first order is wound in a known manner to a spiral wire of the second order and then brought to the final crystal form (long undistorted crystals) by suitable heat treatment.

4. A process for the preparation of a spiral tungsten filament, as claimed in Claim 3, according to which the spiral of the first order is wound on a mandrel of refractory material to a spiral of the second order and this spiral together with the mandrel is heated strongly until the final crystal structure is produced, and the mandrel is then removed.

5. A process for the preparation of a spiral tungsten filament, as claimed in Claim 3, according to which the spiral of the second order together with the mandrel is heated only to about 1900° C. to 2000° C. and then raised to the final temperature after the mandrel has been removed.

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